WE CLAIM:

1. A grating-assisted coupler device, comprising:
a first input/output (i/o) waveguide; and
a coupler unit having
a first coupler waveguide coupled at a first end to the first i/o waveguide,
a second coupler waveguide disposed proximate the first coupler waveguide, light propagating from the first i/o waveguide into the coupler unit launching a first portion of light into the first coupler waveguide and a second portion of light into the second coupler waveguide, and
a grating structure disposed proximate at least one of the first and second coupler waveguides to couple light from the first coupler waveguide to the second coupler waveguide, the grating structure including a periodic structure having a starting end proximate the starting end of the second coupler waveguide and positioned so that the light coupled by the grating structure into the second coupler waveguide from the first coupler waveguide is substantially in phase with the second portion of light launched into the second coupler waveguide.

2. A device as recited in claim 1, wherein the periodic structure is formed by portions of material having a first refractive index embedded within a material having a second refractive index.

3. A device as recited in claim 2, wherein the periodic structure is formed from portions of a relatively high refractive index material embedded within a material of a relatively low refractive index.

4. A device as recited in claim 2, wherein the periodic structure is formed from portions of a relatively low refractive index material embedded within a material of a relatively high refractive index.

5. A device as recited in claim 1, wherein the periodic structure is formed from a basic structure pattern repeated a number of times along the coupler device.

6. A device as recited in claim 5, wherein the basic structure pattern has a duty cycle of approximately 50%.

7. A device as recited in claim 1, wherein the grating structure further includes a lead-in portion extending between the starting end of the periodic structure and a position corresponding to the starting end of the second coupler waveguide.

8. A device as recited in claim 7, wherein the lead-in portion adjoins a first portion of the periodic structure, and a length between a starting end of the lead-in portion and a center of the first portion of the periodic structure is equal to approximately (3/4 + m)P, where m is an integer value and P is an the period of the periodic structure.

9. A device as recited in claim 8, wherein the periodic structure has a duty cycle of approximately 50%.

10. A device as recited in claim 7, wherein the periodic structure is formed by portions of material having a first refractive index embedded within a material having a second refractive index, and the lead-in portion is formed from the material having the first refractive index.

11. A device as recited in claim 1, wherein the i/o waveguide includes an active waveguide.

12. A device as recited in claim 1, further comprising a second i/o waveguide coupled to a second end of the second coupler waveguide and wherein the first coupler waveguide has a second end position along the coupler selected so that light propagating from the second i/o waveguide into the second coupler waveguide and coupled into the first coupler waveguide by the grating structure is approximately in phase with light launched into the second end of the first coupler waveguide from the second i/o waveguide.

13. A device as recited in claim 12, wherein the grating structure includes a second lead-in structure proximate the terminal end of the periodic structure, a terminal end of the second lead-in structure having a position along the coupler approximately the same as a position of the second end of the first coupler waveguide.

14. A device as recited in claim 1, the periodic structure has a period P and the starting end of the periodic structure lies within 0.3P of an optimum starting position where the phase of the light coupled into the second waveguide coupler by the grating structure is exactly in phase with the light launched into the starting end of the second waveguide structure.

15. A device as recited in claim 14, wherein the starting position of the periodic structure lies within 0.25P of the optimum starting position.

16. A device as recited in claim 14, wherein the starting position of the periodic structure lies within 0.125P of the optimum starting position.

17. A laser, comprising:

a gain region including a gain waveguide;

a coupler region including

a first coupler waveguide coupled at a first end to the gain waveguide,

a second coupler waveguide proximate the first coupler waveguide, light propagating from the gain waveguide into the coupler region launching a first portion of light into the first coupler waveguide and a second portion of light into the second coupler waveguide, and

a grating structure disposed proximate at least one of the first and second coupler waveguides to couple light from the first coupler waveguide to the second coupler waveguide, the grating structure including a periodic structure having a starting end proximate the starting end of the second coupler waveguide and positioned so that the light coupled by the grating structure into the second coupler waveguide from the first coupler waveguide is substantially in phase with the second portion of light launched into the second coupler waveguide; and

a reflector region having a reflector waveguide coupled to receive light from the second coupler waveguide.

18. A laser as recited in claim 17, wherein the reflector region includes at least one distributed Bragg reflector.

19. A laser as recited in claim 17, wherein the reflector region includes a sampled Bragg reflector.

20. A laser as recited in claim 17, wherein the reflector region includes a reflector defining a reflection spectrum having multiple reflectivity maxima.

21. A laser as recited in claim 17, wherein the gain region provides optical gain for light having a wavelength in the range 1500 nm - 1620 nm.

22. A laser as recited in claim 17, further comprising a controller coupled to provide gain current to the gain region of the laser.

23. A laser as recited in claim 22, further comprising a laser frequency measurement unit disposed to determine frequency of light output from the laser, the laser frequency measurement unit being coupled to direct a laser frequency signal to the controller, and wherein the controller is coupled to control the frequency of light output from the laser.

24. A laser as recited in claim 22, further comprising an active cooling device disposed to extract heat from the gain region, the controller being coupled to control the active cooling device.

25. An optical communications system, comprising:

an optical transmitter having at least one laser, the laser including

a gain region including a gain waveguide;

a coupler region including

a first coupler waveguide coupled at a first end to the gain waveguide,

a second coupler waveguide disposed proximate the first coupler waveguide, light propagating from the gain waveguide into the coupler unit launching a first portion of light into the first coupler waveguide and a second portion of light into the second coupler waveguide, and

a grating structure disposed proximate at least one of the first and second coupler waveguides to couple light from the first coupler waveguide to the second coupler waveguide, the grating structure including a periodic structure having a starting end proximate the starting end of the second coupler waveguide and positioned so that the

light coupled by the grating structure into the second coupler waveguide from the first coupler waveguide is substantially in phase with the second portion of light launched into the second coupler waveguide; and

a reflector region having a reflector waveguide coupled to receive light from the second coupler waveguide;

a fiber optic link coupled to receive light signals output from the optical transmitter; and

an optical receiver unit coupled to detect the light signals from the fiber optic link.

26. A system as recited in claim 25, further comprising a series of fiber amplifiers disposed on the optical fiber communications link, the series of fiber amplifiers including at least one fiber amplifier unit.

27. A system as recited in claim 26, wherein the at least one fiber amplifier unit includes at least one pump laser coupled to pump a fiber amplifier.

28. A system as recited in claim 25, wherein the optical communications transmission unit includes at least two laser units operating at different wavelengths and further comprising wavelength division multiplexing elements to combine light output from the at least two laser units to produce a multiple channel optical communications signal coupled to the optical fiber communications link.

29. A system as recited in claim 28, wherein the optical communications receiver unit includes wavelength division demultiplexing elements to separate the multiple channel optical communications signal into signal components of different wavelengths and further includes channel detectors to detect respective signal components.

30. A method of forming a coupler, comprising:

forming a first coupler waveguide in a coupler region;

forming a second coupler waveguide in the coupler region over the first coupler waveguide; and

forming a grating structure proximate one of the first and second coupler waveguides, the grating structure including a periodic structure having a starting end positioned relative to a starting end of the second coupler waveguide so that light coupled by the grating structure from the first coupler waveguide into the second coupler waveguide is substantially in phase with light injected into the starting end of the second coupler waveguide when passing light into a starting end of the first coupler waveguide.

31. A method as recited in claim 30, further comprising forming a first input/output (i/o) waveguide coupled to the starting end of the first coupler waveguide.

32. A method as recited in claim 31, wherein the first i/o waveguide is an active waveguide.

33. A method as recited in claim 30, further comprising forming a reflecting structure having a reflector waveguide optically coupled to a second end of the second coupler waveguide, to reflect light propagating from the second coupler waveguide.

34. A method as recited in claim 33, further comprising forming an active waveguide coupled at a first end as the i/o waveguide to the first coupler waveguide.

35. A method as recited in claim 34, further comprising forming an output coupler disposed to reflect light from a second end of the active waveguide.

36. A method as recited in claim 35, further comprising forming a phase control section between the output coupler and the reflecting structure.

37. A method as recited in claim 30, wherein the periodic structure has a period, P, and forming the grating structure includes setting the starting end of the periodic structure within 0.25P of an optimum position where light coupled by the grating structure into the second coupler waveguide is exactly in phase with the light injected into the starting end of the second coupler waveguide.

38. A method as recited in claim 37, wherein the grating structure further includes a lead-in section having a starting end at approximately the same position along the coupler as the starting end of the second coupler waveguide.

39. A method as recited in claim 30, wherein forming the grating structure includes disposing portions of material having a relatively high refractive index in a material having a relatively low refractive index.

40. A method as recited in claim 30, wherein forming the grating structure includes disposing portions of material having a relatively low refractive index in a material having a relatively high refractive index.

41. A method as recited in claim 30, further comprising forming an input/output waveguide before forming the first waveguide, growing a cover layer over the input/output waveguide, etching at least an end of the input waveguide, and growing the first and second coupler waveguides having

starting ends positioned along the coupler at the etched end of the input/output waveguide.

42. A method as recited in claim 41, wherein forming the starting end of the second coupler waveguide includes removing a portion of the second coupler waveguide proximate the etched end of the input waveguide.